# NASA SBIR 2004 Phase I Solicitation

## X3.02 Habitats, Habitability, and Human Factors

**Lead Center: JSC**

### Advanced Habitation Systems

Advanced habitation systems include the overall habitat system and its crew supporting habitability functions within. Habitability systems technologies are being sought to enable Human Exploration and Development of Space Enterprise future orbital, planetary, and deep space applications. Space Station and planetary habitation and habitability systems in areas such as crew work, food, hygiene, rest, logistics, maintenance, and repair systems are being sought out for innovative solutions with regard to reliability, durability, repairability, radiation protection, packaging efficiency, and life-cycle cost effectiveness. Integration of workstations, integrated sensors, circuitry, automated components, integrated outfitting and advanced work station evolution to aid and enable the crew to work autonomously are considered necessary for advanced habitation. Development in crew food systems in the areas of foot heating, preparation, dining, water heating, chilling and dispensing, and trash management enable a cohesive habitable environment for the crew. Technology development in crew hygiene systems such as waste collection, personal hygiene, multi-use equipment, and hygiene evolution enables a habitable environment for the crew.

The Space Station and Crew Exploration Vehicle are of most interest and consideration of flight-testing in space should be considered. Exploration missions such as the Moon, Mars, and planetary transit are of particular interest. Areas in which advanced habitability system innovations are solicited include the following technologies for use in space (zero gravity) and/or planetary surfaces:

Advanced Habitability Systems

Crew Food Systems: Create food systems to package, preserve quality food and lightweight, low power, food preparation systems to support on-orbit crew meal storage, preparation, and dining activities.

Food Heating Systems: Create low power food heating systems to support crew food preparation activities; conduction, convection, microwave, or advanced heating technologies may be considered.

Water Dispensing Systems: Create low power systems that chill, heat, and dispense potable water, which support crew food preparation activities.

Wardroom: Create a wardroom system using deployable or erectable systems, which support crew rest-and-relaxation activities.

Trash Management Systems: Recycling technologies, and dual use technologies.

Crew Hygiene Systems: Create crew hygiene systems that are lightweight, low power, low volume systems to support on-orbit and planetary crew waste and hygiene activities. Create lightweight, low power and low volume technologies for waste collection, gas and liquid separation and urine separation. Create new and/or advanced technologies for crew hygiene, no-rinse hygiene products, and non-foaming gas/liquid separation (technologies which handle soaps). Integrated systems and outfitting: Create new and/or advanced approaches to integrating crew hygiene systems and products into the Space Station, crew exploration vehicle, and planetary vehicles and facilities. Create new approaches to outfitting the Space Station, crew exploration vehicle, and planetary vehicles to accommodate crew hygiene.

Crew Rest Systems: Create crew rest systems that are lightweight, low power, low volume systems to support orbit and planetary sleeping and privacy activities. Create new technologies and/or approaches with regard to the design and implementation of crew quarters, radiation protection, acoustic and noise control, quiet air ventilation, crew relaxation and recreation, and interactive audiovisual systems. Integrated systems and outfitting: Create new technologies and/or approaches to integrating crew rest systems into the Space Station, crew exploration vehicle, and planetary vehicles and facilities. Create new approaches to outfitting the Space Station, crew exploration vehicle, and planetary vehicles to accommodate crew rest and privacy.

**Airlock Systems**

Create airlock systems that are low power and minimum gas loss during operations. Create new technologies with regard to long life and replaceable seals. Create new technologies with regard to low power, long life, and replaceable pumps. Create new approaches to hatch mechanisms for minimum effect to airlock volume during opening and closing.

**Tools for Integrated Testing for Human Exploration Missions**

Future human exploration missions in space will be increasingly complex. In order to carry out these challenging missions, systems engineering and integration activities must be efficient and demonstrated. It will, therefore, be necessary to perform large-scale integrated tests on the ground before undertaking the actual missions.

Integrated ground tests for human exploration missions will provide a test bed not only for hardware, but also for development of requirements, hardware acquisition strategies, novel system concepts, and management. These must all result in systems that are increasingly self-sufficient and sustainable in order to leave Earth for longer periods of time. This subtopic focuses on tools that help technology developers, mission planners, and eventually astronauts to accomplish their various tasks in more efficient and synergistic ways. By developing these tools and using them in ground test beds, they will then be ready for use in the complex human exploration missions of the future.

Specific items solicited for integrated testing of human missions include:

- Tools which help develop, flow down, and verify mission requirements at various levels;
- Novel hardware acquisition strategies for incremental missions;
- Techniques that improve real-time analysis and help minimize the time between integrated tests;
- Novel system concepts for highly integrated systems that result in much lower mass, power, and volume of hardware and consumables;
- Sustainability technologies that capitalize on terrestrial dual-use of the technology to improve development time and support for research and development;
- Novel management techniques for planning, scheduling, and conducting complex integrated mission simulations;
- Tools to develop system level mathematical models of missions and tests that are more intuitive and easier to use than existing ones;
- Computer-based tools that can be used to perform real-time test or mission analysis;
- Systems engineering and analysis tools that make mission architecture studies faster to perform and easier to conduct and communicate; and
- Tools that improve the efficiency and cost effectiveness of integrated testing with humans.